An advantage of the magnetic sensors of the present invention is that they are passive devices, meaning that during operation, the sensors do not consume any external electrical power. In addition, according to certain embodiments, the passive magnetic sensors of the present invention exhibit a field sensitivity of at least 5 mV output signal per Oe of applied magnetic field.

For instance, as described in Example 1 of the present specification (p. 16, line 9 through p. 17, line 4), a three-layer device (as shown in Fig. 1B) of a magnetic amorphous alloy ribbon (FeNiMoSiB) sandwiched by two piezoelectric (PZT) layers was placed in an ac magnetic field, and the output signal from the piezoelectric layers was measured. As shown in Fig. 9, the RMS of the electrical output signal was measured as a function of the strength of the ac magnetic field. Over the linear range of approximately 5 to 15 Gauss for the output signal, the magnetic field sensitivity was approximately 5 mV/Oe. Fig. 10 shows the same measurement performed in the presence of a dc bias magnetic field of 12 Oe. In this case, the sensitivity was even higher, approximately 20 mV/Oe.

In Example 2 (p. 17, lines 5-14), a piezoelectric (PZT) layer was sandwiched by two magnetostrictive ($Fe_{50}Co_{50}$) layers to produce a sensor as shown in Fig. 1C. As illustrated by Fig. 11, these sensors exhibited a sensitivity of approximately 5 mV RMS signal per Oe over a wide linear range.

The Examiner rejected all claims as obvious over GB 2188157, to Oetzmann. For the following reasons, it is submitted that this rejection is overcome.

Independent Claim 8 is distinguishable from the cited Oetzmann reference in that Claim 8 is limited to *passive* devices, in which the multilayer piezoelectric/magnetostrictive sensing element does not consume any external electrical power. Oetzmann, on the other hand, actually *teaches away* from this design by teaching that a passive magnetic field sensor comprising a layer of piezoelectric material between two layers of magnetostrictive material is noisy and unstable in operation.

In fact, the Oetzmann reference directs one of ordinary skill to employ a *non-passive* sensor which includes a power-consuming electromagnet as an essential component. In particular, the Oetzmann patent teaches that a "simple dc sensor arrangement" (p. 1, line121) having a magnetostrictive member secured to a piezoelectric member, with no power-consuming

electromagnet, suffers from a number of critical deficiencies, such as built-up charge of the surface of the piezoelectric member, thermal expansion between the members, and electron drift in the piezoelectric member. These create a parasitic potential difference in addition to the potential difference from the applied magnetic field, "and hence result in the sensor being *noisy and unstable in operation.*" (p. 1, lines 17-24). Accordingly, Oetzmann teaches, "[i]t is an object of the present invention to provide a magnetic sensor in which the above disadvantages are overcome." (p. 1, lines 25-27).

The invention described by Oetzmann utilizes an electromagnet arranged to apply an alternating magnetic field to the sensor. (p. 1, lines 38-39). As shown and described in connection with Fig. 3, the sensor 1,2,3 is placed within a solenoid 4, and in operation, an alternating current is supplied to the solenoid 4 from a source 5. Oetzmann explicitly teaches away from the *passive* (i.e. non-power consuming) magnetic sensors of present invention, and instead directs the ordinarily skilled artisan to adopt a non-passive design in which a power-consuming electromagnet is an essential component of the magnetic sensor. See, e.g., Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc., 230 U.S.P.Q. 416, 419-20 (Fed. Cir. 1986) (district court's reliance on isolated portion of reference was impermissible hindsight obviousness analysis, where complete reading of reference makes it clear that discussion of laser etching of contact lenses was merely to point out disadvantages of this method and to highlight advantages of different method, and where reference as a whole taught away from claimed laser etching method).

The present inventors, on the other hand, have discovered that by optimizing the material properties and structure design of a magnetic field sensor utilizing piezoelectric and magnetostrictive materials, it is possible to produce multilayer *passive* magnetic field sensors for a variety of magnetic field sensing applications, in contrast to what was taught in the art. The advantages of such devices include, for instance, high field sensitivity, wide dynamic range up to several thousand Oersted, low cost in manufacturing, and no need for external power. (See Specification at p. 3, line 18 through p.4, line 19).

In addition, Oetzmann fails to teach or suggest a passive magnetic field sensor comprising magnetostrictive and piezoelectric layers and having a field sensitivity of at least 5 mV output signal per Oe of applied magnetic field, as recited in new Claim 25. Instead,

Oetzmann actually teaches away from this device, where Oetzmann states that a magnetic sensor comprising magnetostrictive and piezoelectric materials (absent an external power source and electromagnet) is "noisy and unstable in operation." Claim 25 of the present invention, on the other hand, is limited to a passive device with a high field sensitivity of at least 5 mV output signal per Oe of applied magnetic field. This further distinguishes the present claims from the teachings of Oetzmann, as Oetzmann explicitly disparages the performance characteristics of a passive device as "noisy and unstable," and directs the skilled artisan to adopt an entirely different design.

As the cited Oetzmann reference fails to teach or suggest the devices claimed in the present application, and instead teaches away from what is now claimed, it is respectfully submitted that the §103 rejection is overcome with respect to Claim 8, and its dependents, Claims 6-7, 9-20, and 24-26.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned at (978) 341-0036.

Respectfully submitted,

HAMILTON, BROOK, SMITH & REYNOLDS, P.C.

By Kevin T. Shaughnessy

Kevin T. Shaughnessy
Registration No. 51,014
Telephone: (978) 341-0036
Facsimile: (978) 341-0136

Concord, MA 01742-9133
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